THE QUALITY MANAGEMENT OF THE SERVICES OF SCIENTOMETRIC QUANTIFICATION OF THE RESEARCH OF THE MEMBERS OF THE UNIVERSITY COMMUNITY DEPLOYED WITHIN THE „E-UNIVROSCIENT" CONCEPT

Ionescu Bogdan[1], Ionescu Iuliana[2], Dumitru Valentin[3] and Gorgan Vasile[4]
[1) 2) 3) 4)] The Bucharest Academy of Economic Studies, Romania
E-mail: ionescub@gmail.com
E-mail: iionescub@ase.com
E-mail: valentin.dumitru@soft-expert.info
E-mail: gorganv@ase.ro

Abstract

The concept called **"e-UnivRoScient" (e-University Romanian Scient)** proposes the search of new opportunities of information and documentation, at the basis level of structuring in the university scientific research – the individual, the collectivity, the chair or the department. By deploying the concept **e-UnivRoScient** in an on line database it permits to obtain a harmonious relationship between the creators of scientific information from the level of the university degree units and its consumers, through the achievement of an informational system with visible database at the national level, which will present the scientific preoccupations of the university researchers under all the aspects and components of the research activity. By synthesizing and weighting all the components of the research activity it can be obtained the profile of a researcher which activates in the university environment, joining normative assessment rules for the evaluation of scientific activity with rules resulted from an empirical research. This concept will approach the university research on the principle of a scientific exchange in which the academic community will participate. The aspects presented in this paper have an original character and fulfill in the opinion of the authors with qualitative elements the scientometric quantification of the scientific research management.

Keywords: scientometrics; research scientific portfolio; scientific research; researcher's profile; online database

JEL Classification: O32

Introduction

In a world governed by knowledge, the science has a universal character. In this context, the main goal of the scientific research is that, starting from the data to the information, we will obtain knowledge in information knowledge pyramid. Without communicating the results of the scientific researches in order to utilize them further on in the research, it will be cancelled from the very beginning this role played by science in the modern society.

Passing to an economy based on knowledge, represents a fundamental strategic option and it will have a great impact over the global sustainable development of mankind. The universities play a vital part in the development of the society, based on the knowledge through the contribution brought to the production, transferring, dissemination and utilization of information in the process which transforms data in information and knowledge (Bramwell & Wolfe, 2005; Conceicao, Heitor, & Oliveira, 1998).

1 Critical analysis of the degree of information concerning the scientific research

According to the requirements of the Bologna process (Bada, 2008), convergent with the conclusions of the Berlin conference (Berlin, 2003) and with the National Strategy of the Universities in Romania (Bucharest, 2003), the research activities became basic parts of the evaluation of the professors activity system. The university system of evaluation of the research activity contains partially the individual and/or the collective research activity, and in case it contains all the scientific components of the research activity, these ones will be described only at the level of the university or of the academy, the information not being connected with the other existing components at the level of other research entities (national or university). Romania, as a signatory country of the Bologna document (Bologna, 1999) has committed since the start of the process to join other European countries in joint efforts to create a European Area of Higher Education and Research (Parvu, 2007).

The universities from Romania represent a component part of the European space at the university degree. In this context, so that the research can become visible, efficient, specialized, but also interdisciplinary, *the profile of university researchers must be as well defined as it can be*. The research should go beyond, both on a vertical axis of the pyramid of knowledge, starting from data to information reaching knowledge, but also on a horizontal axis which implies the individual researcher, the collectivity or the research team, the chair or the research department, the academic unit or the research institute towards the national entities or the release, evaluation, reporting and dissemination of research forums.

If the vertical axis of the formation of knowledge through research is regulated by the research characteristics on thematic areas, the horizontal axis (axis the authors call "institutional") is only visible in the final part of the segment, meaning at the university level through specialized departments in research or at the level of entities which launch research grants, conferences, symposia, seminars, workshops. The first part of the horizontal segment is almost opaque, because the research appears from the organizational point of view most frequently at a superior level: faculty, university or research institute. At the inferior level of this axis we can identify researchers, at the individual level or grouped in collectivities and distributed to some themes or research grants. The amount of scientific skills for this segment, ventilated by category, topic areas, competences etc., can determine both the profile of each university researcher and the profile of the chair or of the department it belongs to, from the organizational point of view.

The department (or chair) is considered the primary provider of resources gained through scientific research, as well as the final consumer of the results of the research, which refueled the scientific wish shown by scientific research with new topics and research themes. The major manifestation of scientific research at the organizational entity level

(department or chair) represents the disclosure of the scientific competences of its members, in the context that the Romanian universities proposes themselves to became, firstly, research centers. If this segment would be valued from the informational point of view, in order to enlarge the visibility by defining the researchers attributes, the research collectivity, to the chairs or department, quantifiable benefits would be brought in terms of value which would increase the efficiency of the research on the vertical axis of knowledge, through the identification of similar preoccupation of researchers which can define the present step of the research in the area, an on the horizontal axis (in the final part of the segment), in the sense of mixing together sources of dissemination of scientific concerns.

The analysis of the present state of the research in the area of promoting the science politics and scientometric is located at the level of identifying the main entities with local, national and international visibility in the science politics and supposes the analysis of the way they can offer descriptive information about the research projects, articles, scientific papers, books etc., and the way that a profile of the researcher can be obtained by combining those items and that a scientific potential of the chairs and departments with members involved in the scientific activities can be obtained.

The national entities (www.cncsis.ro; www.cnmp.ro) involved in the science politics don't deal with the relationship between the research resources at different levels that supply them (on the information track researcher – research team – university chair – faculty – university), on domains, subdomains, themes. The nice identified at this level could ventilate in terms of information, projects eligible or declared winner of the competition for grants using any criteria, not only on domains, subdomains, themes and universities or research institutes. We consider that this information in conjunction with the objective of disseminating national and international research results should be included in a database, as amalgamations of information resources released by a heterogeneous participate in competitions and research grants.

Extrapolating the reasoning exposed above at the other levels of scientific research (articles, conferences, scientific books etc.) we can infer that the research components, disparate temporally and spatially, are visible only in relation to the entity (publisher, journal, conference) promoting them. *There is no information anywhere to unite at researcher or team level all the articles published in various scientific journals, all the papers presented at conferences or all the books printed in publishing houses.* The university researchers evaluate the management system of the research in the superior education, as lacking consistency in the conditions in which the research activities are hard to be managed (Scott, 2003).

These elements result from the change of the reporting structure of the scientific product of the universities after 2003. The old reporting form was meant for the basic entities: the chair and the faculty, linking directly the scientific production and its users, while the new form gathered the scientific production at the level of the research centers and departments. These structural changes in reporting the research components from universities induce informational redundancies and parallel structures for the research assessment. The Ministry of Education, Research and Innovation issues periodically norms for the quantification of the scientific production on research components that can change in time, concerning the percentage of these components in a portfolio that evaluates the fulfillment of scientific criteria by the members of an academic community. Frequently, these criteria emphasize some elements instead of others, changing the structure of the requests,

changing and moving the nucleus of the assessment criteria. Lots of elements in the scientific portfolio of a researcher (for instance, the number of points obtained by participating in national or international competitions in activities that are not financed) are not taken into account. These "sleeping" and somehow complementary elements to the present assessment indicators of the scientific performances can be stored in a database. The information extracted could become valuable in a process of research management under the circumstances in which the science politics suffer quantitative and qualitative changes.

This reasoning motivates the existence of a unifying concept of the resources released from the research undertaken by the members of the academic community. This concept is called the by the authors **"e-UnivRoScient"**. We encountered several sites for cataloguing and quantifying the scientific resource produced by the research, but they only cover in part and unrelated the information concerning the scientific products of the individuals or entities involved in the scientific production. Most of the Romanian universities initiate integrated projects of academic management that contain classical elements (unanimously recognized by the specialized literature) of students, education and research management (Marti Harris, 2008). These systems rely a lot on the integrated systems technologies like ERP that try to unify and standardize from the informational point of view the operational systems from the universities. Practically, all the information from such a system are stored in only one database (Kwon et al., 2008). Bucharest Academy of Economic Studies initiated in 2008 an institutional project called S.I.I.M.U. (Integrated Informatics System of Universitary Management) that offers a new vision on the educational process management, by which the didactic activities are directly managed by the academics or by the teams of the disciplines without passing through any intermediary institutional departments (SIIMU, 2009).

Some universities from Romania (Babes-Bolyai University form Cluj (info.ubbcluj.ro/cercetare), Economics and Business Administration Faculty from Iaşi (www.feea.uaic.ro/catedre)) initiated mostly the development of research activities, structures on departments, faculties and academics, with the possibility of summarizing the results at the level of different structures. Concerning the unification of the research resources available at the level of the organizing units in ASE isolated efforts are made, at the initiative of several departments. The scientific reports of the departments on research components are difficult to manage and synthesize in the absence of a tool that structure and normalize the quantitative and qualitative information of the scientific production. The scientific research management at the level of organizational entities of the universities has to deploy first of all the standardization of the scientific reporting. Not identifying the scientific products with the departments or scientific centers hugely restricts the quality of the management of the scientific research.

Even though the research activities at the department's level start to become visible in the faculty or university, there isn't yet the possibility to integrate this information into a national database, multicriterially indexed, that contains the research resources produced by each department, research team or person.

2. Designing an online database that interconnects the categories of scientific concerns, at the convergence of the interests of creators and consumers of scientific information

The **e-UnivRoScient** concept aims to create a database that interconnects individual researchers, research teams, specialized departments of universities, at the convergence of the interests of creators and consumers of scientific information. The database will contain all the descriptive information of the research concerns of the members of the chairs. This information will be cataloged and indexed by various criteria that can provide various competences describing and assessing the research activity at the individual, research team or specialized chair. Basically, any scientist in Romania or in the world can access this portal and will be able to obtain both information on the scientific portfolio of individual researchers or university chairs and the scientific profile of these researchers, in relation to certain criteria of scientometric quantification.

From an operational point of view, **e-UnivRoScient** concept offers each researcher or university department that would wish to promote the ideas and results of its researchers the possibility to provide descriptive information on its own potential or research portfolio. The database will be loaded by the system's users. In order to be registered in the database, researchers must publish their scientific concerns ventilated by category (books, articles, research contracts etc.) and after such an approach they receive from the system a registration time. By granting access to the online platform, a scientific committee will check the portfolio of the scientific papers of the potential users (at the level of the department – the scientific council, at the level of the research center of the faculty – the scientific committee or at the level of the university – the office of academic assessment). Following this examination, according to the results found and the degree to which the declared works were identified, a score of authenticity is to be awarded. If a minimum number of points are obtained, the user is allowed to access the platform. These facilities represent qualitative components of any process of operational management of the scientific research. The application will have a management interface (like the balanced scorecard) in which the quantitative aspects of the research resources of each person, team and department will be connected with derivative elements like: subjects, research themes etc. In this interface different sets of criteria will be introduced, quantified in scoring points, according to the present or future interest of the entity making the scientometric assessment. For instance, in a certain moment, to the profile of the researcher will be attached assessment systems of the scientific production, where at a certain moment in time the grant or competition research will be emphasized or at another moment in time will be first analyzed the quality of the papers according to the type of journals and impact factor. Such scientific criteria can be stored in a table of the database in accordance with the requests included in the rules for promoting the academics (Order 5099 MEdC/3.10.2005 and completed by Order 3548/6.04.2006 – for occupying the associated professor positions and Order 5098/3.10.2005 and completed with Order 3548/6.04.2006 – for occupying the academics positions).

Materialization of the concept of **e-UnivRoScient** in an on-line database will allow for fast and complex searches, sort of research resources and will allow the display of lists of books, articles, contracts, grants with disseminated results etc., that meet the selection criteria, specifying the generic identification elements: author(s), title, scientific event, editor, scientific database, the date of publication, ISBN/ISSN.

Exhaustive transposition of the requirements for the dissemination of the individual or group research results in a relational model to provide the completeness of an on-line database is centered on a table with researches results that relates to all the components of a research portfolio, inducted by scientific papers. Scientific works are presented on the relational model of the database on the components that form a research portfolio (books, articles published after attending conferences, articles published in scientific journals, research grants, books, patents, inventions, products developed as a research result, doctoral theses etc.). The flexibility of the adopted model consists in the possibility of adding any research component defined in relation with a scientific paper, result of the research. Thus, the model can be completed by defining other academic or extra-academic concerns except the research: symposia, workshops, participation in creating references (books, study books, case studies, lecture notes) and doctoral research (doctoral reviews) etc.

The conferences are a part of the relational model of the database and are declared national or international, have a date on which they are scheduled, are organized by faculty and are usually associated with journals or publications (identified by ISSN or ISBN codes). Scientific papers published as results of the scientific research are associated with the appearances in the journals. Given the fact that the journals are evaluated periodically by the authorities implementing science policy at national or international level, their qualification fluctuates in time, so that the journals may be differently scientifically quoted over a period of time. Therefore, the relational model presents a multiple combination which shall state the quotation of the journal for each of its occurrence.

The association of the scientific papers with grants for scientific research is reversed to the articles and conferences in the sense that a research grant type may have more results disseminated in the form of scientific papers. The team or group of researchers is very important for the **e-UnivRoScient** concept. This team brings together many researchers, participating in the same time for the achievement of a research project. The efforts of the researchers who participate in the grant are materialized as results of the research and become visible and opposable through the scientific papers that have full connections with all components of a research portfolio.

The model imposed by the concept of unification of the research components and in the same time of the dissemination of the portfolio of these components presents the hierarchy of the research domains. The main scientific fields search in the database is those stated by the bodies involved in the science policy. Each main field can be divided into several domains. Also, within these domains, there may be more subclassifications in the form of research themes, and they can drill down on topics.

According to the association made between the research topic – as a separate primary entity classification (which transits by topic, subdomain, research field and study) and "Scientific_Paper" all the research results can be ventilated in relation to the classification and hierarchy of the science domains. In this way, the concept **e-UnivRoScient** implemented in an on-line database may allocate to any individual scientist or group, any component of a research result, ventilated by the main categories of the science domains. In fact, this concept allows the creation of an infrastructure of scientific socialization for the researchers.

The human research component involved in **e-UnivRoScient** concept is materialized in tables describing the individual researcher and the topical issues in which they act. The association of the scientific work carried out as results of the research and the individual researcher is achieved through a link table.

In most cases, the chair (or the department, according to the functional organization chart), the primary storage system of the scientific potential in a university, doesn't issue significant items from the scientific research point of view. Its presence is noticeable only at historical level, as an administrative component or from an academic perspective. Some departments publish their research themes according to thematic area or field which are part of that theme, without any concern regarding the research human resource. Also, there are cases where scientific concerns are visible from a quantitative view: published books (with authors, publisher, year), articles, conferences, etc.

Even if research activities at an individual, team or department level are beginning to become visible from a faculty or university (or research institute) perspective, for now there is no possibility to aggregate these information in a national, multicriterial indexed database, which contains research resources issued by each department, group or individual.

The management of the scientometric quantification services of the scientific products can be approached from a quantitative point of view on more than one level: at the level of a person, research team, department, faculty or university, national (or international) forum, in connection with the items classifying the scientific production on domains, subdomains, subjects or topics, disposed according with a temporal coordination.

3. Contributions to the qualitative development of the scientific production quantification services, implemented through e-UnivRoScient concept

The concept **e-UnivRoScient** contributes with two original elements to the process of the qualitative management of the scientific production, namely: *the deployment of the stock exchange concept in the approach of the scientific research* and *the modeling of the scientific profile of a researcher*.

We believe that national and international visibility of research concerns of individual or teams that belong to institutional entities with scientific vocation obtained through **e-UnivRoScient** will lead to a huge portfolio of research themes and concerns, thematic areas, organized on specialized themes or interdisciplinary. Likewise, by gathering all the information regarding academic research around the research providers (individual, team, department) one can lay the foundation of a research market through which all research resources (human resources, scientific portfolios, skills portfolio, ideas etc.) can be negotiated.

This institutional component defined by the **e-UnivRoScient** concept is materialized through tables which refers researchers' membership. These can belong, from an institutional point of view, to a department which belongs to a faculty, which in turn belong to universities or research institutes.

This institutional component defined by the concept **e-UnivRoScient** is materialized in tables that refer to the membership of the researchers (from the institutional point of view they can be part of a department that belongs to a faculty, which at its turn belongs to a

university or research center).

The **e-UnivRoScient** concept offers visibility to the scientific research results in all their forms of manifestation, dissemination and appliance, and is a premise to see the scientific research as a market, dominated by the scientific supply and demand. According to stock exchange principles, the information offer can include the entities which offer research grants (national, international and even entities from business environment) and individual researchers or research teams which wish to attract coworkers on specific fields of their scientific concern. The information demand can emanate from every member of a scientific community (in the presence of a minimum guarantee of eligibility in terms of scientific concerns). At the confluence of supply and demand, the research project is also valuable in solving interdisciplinary issues identified by the scientific concerns of the research teams, which means finding competent persons from a scientific point of view, in departments with other specific than the one in which the research team works.

The implementation of the stock exchange principle in the **e-UnivRoScient** database is the result of association between the research results (with all implemented sides through scientific work), the human and institutional component with the table which describes the scientific subjects which relate every researcher with a research field.

Under the existence of this association between each researcher and scientific subjects through which the research abilities are described one can shape a research market which will lead to a hierarchy of the most wanted researchers, themes, grants, scientific magazines organized on various scientific fields.

The advantages of treating the scientific research component as a "resources exchange" are located at the level of the following coordinates:

- Can be identified scientific ideas and concerns related to other collective research or other university departments (these can be strong points of eligibility in the national or international competitions for grants);
- Complementary problems for the research themes outlined at the research group level can be identified in order to participate in research consortia. The complementarities of research ideas can be placed horizontally (e.g. between related subdomains of the same scientific field) or vertically (between sciences belonging to different domains);
- Can identify potential beneficiaries of the research (e.g. business community members can manifest their interest in specific research themes or on the basis of an analysis of market research, organizers of conferences and symposia have the opportunity to become more selective when addressing participation invitations).

A second element of originality which is considered by the authors to be qualitatively in the field of scientometric measuring is represented by the *definition of a researcher scientific profile*. This profile can be shaped through parallel analysis of the assessment criteria accepted by the higher education scientific community, related to the normative approach defined by the regulators which implement the science policy. As a result of this approach, the scientific profile of a researcher can be shaped, according to his scientific portfolio which results from the analysis of the research components.

The definition and use of criteria able to classify academic researchers, in terms of areas of competence can follow the norms promoted by the laws, ordinances, order of the ministry of Education, Research and Innovation or science politics forums, but may also define other points of view empirically chosen (after surveying the academic community). Thus, it can be modeled and created a profile of an academic researcher on the basis of criteria which outlines as accurately as possible its scientific concerns, emerged from the different rotation criteria extracted from the database. According to the structure or the portfolio of his scientific work a scoring may be given, to measure its scientific value.

The importance of such a concept to evaluate the quality of research through scientometric indicators lies in the harmonization of research at individual, group, chair (or department) level with the institutional research reporting system which is implemented by the evaluation offices of the universities through the indicator IC6-2008 (http://www.cncsis.ro/IC8/2008_files/3_2008lucru.pdf). The **e-UnivRoScient** concept manages all the research components issued by individuals, research teams and chairs/departments in relation to different normative criteria for assessing the quality of science. Pivoting these criteria through queries on the database the system will be able to adapt quickly to any regulatory changes that contributes to the qualification of a scientist. This concept implemented through an on-line database populated with data may facilitate the adjustment of the rules of the academic assessment to the requirements and research potential of the academic scientific community.

Defining a database that will store all the elements of a portfolio of research results of an individual, group or institutional entities where these researchers are subordinate is a premise to the deployment of *qualitative scientometric quantification services of the research of a whole university community*.

This growing approach of the aggregation of the information on research (from individual research, to departments and also the upper academic education structures, such as college, university), can confer to each entity an academic scoring for each echelon in part, on different criteria to correspond to scientific works (articles ISI, category B + papers, B papers, grants, conferences etc.) associated with research results. Equally, the results of such a concept can provide for the internal auditors, in any of the universities wishing to implement this service, situations that will allow the assessment of the quality of the research developed at the individual level, department, as well as at college or university level.

The qualitative exploiting of the databace can be seen as another component of the quality management in relation to scientific research. This qualitative component is based on tools which are specific to decision support systems such as data mining which is capable to discover and/or analyze the presence of a pattern or of other information hidden in the data which contains the research components of the scientific community members. This exploration approach repeats heuristically until it confirms or invalidates the hipothesys on which the objectives proposed by scientfic research management system relies. The exploration method of the data through which one acts using successive interactions, in order to discover and examine the results which are compared with those hypothesis, is called in the field of decision support systems „process or method of verification" (William, 1992).

By contrast to this exploration of the data, the „discover" method appears, which uses the new tools and technologies of the new paradigm of decision support systems to discover different types of information hidden in data (Creese, 2004) and returns the information in such a way as to meet the requirements on which a qualitative assessment of scientific production is built, all these being achieved with a minimum effort of the user. These approaches use an entire new range of techniques and methods of analysis, designed to highlight new information through specific investigation techniques. One can distinguish several steps directed to the use of neural networks, models based on decision trees, statistical tools, classifications and inductive rules. Moreover, applying data mining algorithms, can determine which groups of researchers have converged research objectives on the basis of common characteristics hidden in data, invisible when using other analysis tools. Using the same techniques one can shape the profile of a researcher which will lead to more effective research teams.

The proposed database could be implemented both centrally and at each higher education institution. When using the database in a multidimensional environment, at the level of each university or national scientific research valuation center, the potential of the **e-UnivRoScient** concept is expanded so that it aggregates directly unnormalized data into data warehouses and OLAP platforms.

If the centralized variant is chosen, the database can be easily accessed through a web interface. When the database is implemented locally, tools to integrate data must be defined. In this sense we propose the definition of a standard language based on XML in relation to the structure of data that must be integrated. Such languages already exist for different fields: XBRL for financial reporting (Stoica, 2004), XSIL (Extensible Scientific Interchange Language) for scientific data change etc. Data stored using this XML based language will be exposed through web services. In this case the academic education entities involved in the project will have the freedom to choose whatever database platform they prefer, or even the database structure as long as the data exposed through web services observe the presentation standard. Every entity interested in integrating data can access them through these services. In time, the volume of the data can increase significantly, so that, in order to create analysis reports effectively, a data warehouse can be implemented to facilitate multidimensional analysis using OLAP applications. Through roll-up and drill-down operations aggregate data contained by OLAP cubes (BDASEIG Group, 2004) can be visualized at various levels of details such as the higher education institution, the faculty, the chair or department, the research team, the individual researcher.

4. Conclusions

The importance of the concept e**-UnivRoScient** for the actors involved in the creation, dissemination and evaluation of the scientific resource at universities in Romania, in the context of the improvement of the quantification services of the scientific products, can be summarized on the following ideas:

- the university researcher is informed about different scientific resources of topical interest treated by the specialized publications. The scientific fields on which the search criteria will be calibrated will the one preferred by the national university or private entities which define the science policy in Romania;

- the consumers, the suppliers and the assessors of scientific information are interconnected at the level of an individual, team or institution;
- services for making the hierarchy of major scientific fields, subfields, themes and topics are offered. This will eventually lead to assessment criteria of the scientific abilities of the scientific community members;
- **e-UnivRoScient** offers information services for the experienced researchers, but also for the potential developers of scientific information on the contents of similar concerns and works, on the existence of topics and alternative specialized papers, complementary to their competences. Practically, we implement the reporting of the research results of "one" person versus "others";
- the concept balances the demand for scientific information to offer an exchange in the form of ideas, topics and research themes. Through the database the visibility of the individual, group or academic entity results achieved by scientific research will increase, research results being included all together in a portfolio;
- the concept allows the information modeling of the profile of university researcher by analyzing his portfolio of scientific research;
- the concept creates the appropriate conditions to design a scientometric reporting system of the members of the scientific academic community, as close to their actual achievements as possible.

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